

What is claimed is:

1. A method of cleaving a 13-hydroperoxide of linoleic or α -linolenic acid into a C₆-aldehyde and a C₁₂-oxocarboxylic acid comprising contacting the 13-hydroperoxide with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:1, thereby cleaving the 13-hydroperoxide.

2. A method of preparing n-hexanal, 3-(Z)-hexen-1-al, 2-(E)-hexen-1-al, or their corresponding alcohols from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13-hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- (a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:1, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into n-hexanal or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid into 3-(Z)-hexen-1-al; and either
- (b) recovering the n-hexanal or 3-(Z)-hexen-1-al;
- (b') reducing the n-hexanal into n-hexanol or the 3-(Z)-hexen-1-al into 3-(Z)-hexen-1-ol and recovering the hexanol or 3-(Z)-hexen-1-ol; or
- (b'') isomerizing the 3-(Z)-hexen-1-al under temperature and pH conditions effective to obtain 2-(E)-hexen-1-al and either recovering the formed 2-(E)-hexen-1-al or reducing the 2-(E)-hexen-1-al to 2-(E)-hexen-1-ol and recovering the 2-(E)-hexen-1-ol from the medium.

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3. A method of preparing a C₆- aldehyde, a C₁₂-oxocarboxylic acid, or their corresponding alcohols, from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- (a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:1, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into the C₆- aldehyde and the C₁₂-oxocarboxylic acid; and either
- (b) recovering the C₆- aldehyde or the C₁₂-oxocarboxylic acid;
- (b') reducing the C₆- aldehyde or the C₁₂-oxocarboxylic acid to their corresponding alcohols and recovering the alcohols; or
- (b'') isomerizing the C₆- aldehyde or the C₁₂-oxocarboxylic acid under temperature and pH conditions effective to obtain the isomeric forms thereof and either recovering the isomeric forms or reducing the isomeric forms and recovering their corresponding alcohols from the medium.

4. A method of cleaving a 13-hydroperoxide of linoleic or α -linolenic acid into a C6- aldehyde and a C12-oxocarboxylic acid comprising contacting the 13-hydroperoxide with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:2, thereby cleaving the 13-hydroperoxide.

5. A method of preparing n-hexanal, 3-(Z)-hexen-1-al, 2-(E)-hexen-1-al, or their corresponding alcohols from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:2, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into n-hexanal or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid into 3-(Z)-hexen-1-al; and either
 - recovering the n-hexanal or 3-(Z)-hexen-1-al;
 - reducing the n-hexanal into n-hexanol or the 3-(Z)-hexen-1-al into 3-(Z)-hexen-1-ol and recovering the hexanol or 3-(Z)-hexen-1-ol; or
 - isomerizing the 3-(Z)-hexen-1-al under temperature and pH conditions effective to obtain 2-(E)-hexen-1-al and either recovering the formed 2-(E)-hexen-1-al or reducing the 2-(E)-hexen-1-al to 2-(E)-hexen-1-ol and recovering the 2-(E)-hexen-1-ol from the medium.

6. A method of preparing a C₆-aldehyde, a C₁₂-oxocarboxylic acid, or their corresponding alcohols, from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:2, thereby converting the 13-hydroperoxy-octadeca-9,11-

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dienoic acid into the C₆- aldehyde and the C₁₂-oxocarboxylic acid; and either

- (b) recovering the C₆- aldehyde or the C₁₂-oxocarboxylic acid;
- (b') reducing the C₆- aldehyde or the C₁₂-oxocarboxylic acid to their corresponding alcohols and recovering the alcohols; or
- (b'') isomerizing the C₆- aldehyde or the C₁₂-oxocarboxylic acid under temperature and pH conditions effective to obtain the isomeric forms thereof and either recovering the isomeric forms or reducing the isomeric forms and recovering their corresponding alcohols from the medium.

7. A method of cleaving a 13-hydroperoxide of linoleic or α -linolenic acid into a C₆- aldehyde and a C₁₂-oxocarboxylic acid comprising contacting the 13-hydroperoxide with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:3, thereby cleaving the 13-hydroperoxide.

8. A method of preparing n-hexanal, 3-(Z)-hexen-1-al, 2-(E)-hexen-1-al, or their corresponding alcohols from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13-hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- (a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:3, thereby converting the 13-hydroperoxy-octadeca-9,11-

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dienoic acid into n-hexanal or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid into 3-(Z)-hexen-1-al; and either

- (b) recovering the n-hexanal or 3-(Z)-hexen-1-al;
- (b') reducing the n-hexanal into n-hexanol or the 3-(Z)-hexen-1-al into 3-(Z)-hexen-1-ol and recovering the hexanol or 3-(Z)-hexen-1-ol; or
- (b'') isomerizing the 3-(Z)-hexen-1-al under temperature and pH conditions effective to obtain 2-(E)-hexen-1-al and either recovering the formed 2-(E)-hexen-1-al or reducing the 2-(E)-hexen-1-al to 2-(E)-hexen-1-ol and recovering the 2-(E)-hexen-1-ol from the medium.

9. A method of preparing a C₆- aldehyde, a C₁₂-oxocarboxylic acid, or their corresponding alcohols, from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13-hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- (a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:3, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into the C₆- aldehyde and the C₁₂-oxocarboxylic acid; and either
 - (b) recovering the C₆- aldehyde or the C₁₂-oxocarboxylic acid;
 - (b') reducing the C₆- aldehyde or the C₁₂-oxocarboxylic acid to their corresponding alcohols and recovering the alcohols; or

(b'') isomerizing the C₆- aldehyde or the C₁₂-oxocarboxylic acid under temperature and pH conditions effective to obtain the isomeric forms thereof and either recovering the isomeric forms or reducing the isomeric forms and recovering their corresponding alcohols from the medium.

10. A method of cleaving a 13-hydroperoxide of linoleic or α -linolenic acid into a C₆- aldehyde and a C₁₂-oxocarboxylic acid comprising contacting the 13-hydroperoxide with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:4, thereby cleaving the 13-hydroperoxide.

11. A method of preparing n-hexanal, 3-(Z)-hexen-1-al, 2-(E)-hexen-1-al, or their corresponding alcohols from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13-hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:4, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into n-hexanal or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid into 3-(Z)-hexen-1-al; and either
- recovering the n-hexanal or 3-(Z)-hexen-1-al;
- reducing the n-hexanal into n-hexanol or the 3-(Z)-hexen-1-al into 3-(Z)-hexen-1-ol and recovering the hexanol or 3-(Z)-hexen-1-ol; or

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(b'') isomerizing the 3-(Z)-hexen-1-al under temperature and pH conditions effective to obtain 2-(E)-hexen-1-al and either recovering the formed 2-(E)-hexen-1-al or reducing the 2-(E)-hexen-1-al to 2-(E)-hexen-1-ol and recovering the 2-(E)-hexen-1-ol from the medium.

12. A method of preparing a C₆- aldehyde, a C₁₂-oxocarboxylic acid, or their corresponding alcohols, from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:4, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into the C₆- aldehyde and the C₁₂-oxocarboxylic acid; and either
- recovering the C₆- aldehyde or the C₁₂-oxocarboxylic acid;
- reducing the C₆- aldehyde or the C₁₂-oxocarboxylic acid to their corresponding alcohols and recovering the alcohols; or
- isomerizing the C₆- aldehyde or the C₁₂-oxocarboxylic acid under temperature and pH conditions effective to obtain the isomeric forms thereof and either recovering the isomeric forms or reducing the isomeric forms and recovering their corresponding alcohols from the medium.

13. A method of cleaving a 13-hydroperoxide of linoleic or α -linolenic acid into a C₆- aldehyde and a C₁₂-oxocarboxylic acid comprising contacting the 13-hydroperoxide with a recombinant protein produced by a vector comprising a

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nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:6, thereby cleaving the 13-hydroperoxide.

14. A method of preparing n-hexanal, 3-(Z)-hexen-1-al, 2-(E)-hexen-1-al, or their corresponding alcohols from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

- (a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:6, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into n-hexanal or the 13 hydroperoxy-octadeca-9,11,15-trienoic acid into 3-(Z)-hexen-1-al; and either
- (b) recovering the n-hexanal or 3-(Z)-hexen-1-al;
- (b') reducing the n-hexanal into n-hexanol or the 3-(Z)-hexen-1-al into 3-(Z)-hexen-1-ol and recovering the hexanol or 3-(Z)-hexen-1-ol; or
- (b'') isomerizing the 3-(Z)-hexen-1-al under temperature and pH conditions effective to obtain 2-(E)-hexen-1-al and either recovering the formed 2-(E)-hexen-1-al or reducing the 2-(E)-hexen-1-al to 2-(E)-hexen-1-ol and recovering the 2-(E)-hexen-1-ol from the medium.

15. A method of preparing a C₆-aldehyde, a C₁₂-oxocarboxylic acid, or their corresponding alcohols, from 13-hydroperoxy-octadeca-9,11-dienoic acid or 13 hydroperoxy-octadeca-9,11,15-trienoic acid, comprising

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(a) contacting the 13-hydroperoxy-octadeca-9,11-dienoic acid or the 13-hydroperoxy-octadeca-9,11,15-trienoic acid with a recombinant protein produced by a vector comprising a nucleic acid encoding a fatty acid 13-hydroperoxide lyase comprising the amino acid sequence set forth in SEQ ID NO:6, thereby converting the 13-hydroperoxy-octadeca-9,11-dienoic acid into the C₆-aldehyde and the C₁₂-oxocarboxylic acid; and either

(b) recovering the C₆-aldehyde or the C₁₂-oxocarboxylic acid;

(b') reducing the C₆-aldehyde or the C₁₂-oxocarboxylic acid to their corresponding alcohols and recovering the alcohols; or

(b'') isomerizing the C₆-aldehyde or the C₁₂-oxocarboxylic acid under temperature and pH conditions effective to obtain the isomeric forms thereof and either recovering the isomeric forms or reducing the isomeric forms and recovering their corresponding alcohols from the medium.